

CLAIMS

What is claimed is:

1. A method of calculating the radiated sensitivity of a mobile terminal

comprising:

5 determining a reference sensitivity of the mobile terminal positioned in a
reference orientation;

estimating an antenna gain of a mobile terminal antenna when the mobile
terminal is positioned in a test orientation; and

adjusting the reference sensitivity based on the estimated antenna gain to

10 calculate the sensitivity of the mobile terminal positioned in the test
orientation.

2. The method of claim 1 wherein estimating the antenna gain of the mobile

terminal antenna when the mobile terminal is positioned in the test orientation

15 comprises:

applying a known power level to the mobile terminal antenna when the mobile
terminal is positioned in the test orientation; and

comparing the known antenna power level to a measured power level

reported by the mobile terminal to estimate the antenna gain.

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3. The method of claim 2 wherein adjusting the reference sensitivity based on

the estimated antenna gain to calculate the sensitivity of the mobile terminal

positioned in the test orientation comprises calculating the sensitivity, S , of the mobile

terminal according to:

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$$S = P_A - P_{meas} + S_r,$$

where P_A represents the known antenna power level, P_{meas} represents the measured power level, $P_A - P_{meas}$ represents the estimated antenna gain, and S_r represents the reference sensitivity.

5 4. The method of claim 1 further comprising determining a correction factor for each of a plurality of measured power levels reported by the mobile terminal.

5. The method of claim 4 wherein determining the correction factor for each of the plurality of measured power levels comprises:

10 applying a plurality of known power levels to an input of a receiver of the mobile terminal; and

comparing each of the known power levels to a corresponding measured power level reported by the mobile terminal to determine the correction factor for each measured power level.

15 6. The method of claim 4 wherein determining the reference sensitivity of the mobile terminal positioned in the reference orientation further comprises applying the corresponding correction factor to the reference sensitivity to determine a corrected reference sensitivity.

20 7. The method of claim 4 wherein estimating the antenna gain of the mobile terminal antenna comprises:

applying a known power level to the mobile terminal antenna when the mobile terminal is positioned in the test orientation;

25 applying the corresponding correction factor to a measured power level reported by the mobile terminal to determine a corrected power level; and

comparing the known antenna power level to the corrected power level to determine a corrected estimate of the antenna gain.

8. The method of claim 4 wherein adjusting the reference sensitivity based on
5 the estimated antenna gain to calculate the sensitivity of the mobile terminal positioned in the test orientation comprises calculating the sensitivity, S , of the mobile terminal receiver according to:

$$S = P_A - P_{corr} + S_{corr},$$

where P_A represents the known antenna power level, P_{corr} represents the measured 10 power level as corrected by the correction factor, $P_A - P_{corr}$ represent the estimated antenna gain as corrected by the correction factor, and S_{corr} represents the reference sensitivity as corrected by the correction factor.

9. The method of claim 4 further comprising determining the correction factors 15 for one or more frequency channels.

10. The method of claim 1 wherein determining the reference sensitivity of the mobile terminal positioned in the reference orientation comprises:

applying a known communication signal at one or more known antenna power 20 levels to the mobile terminal antenna when the mobile terminal is positioned in the reference orientation;
receiving a looped-back version of each communication signal and corresponding measured power level;
calculating a signal quality of each looped-back version of the communication 25 signal;

comparing each of the calculated signal qualities to a predefined signal quality; and

identifying the reference sensitivity as the measured power level that generally corresponds to the predefined signal quality.

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11. The method of claim 10 wherein the signal quality is a bit error rate.

12. The method of claim 10 wherein the signal quality is a frame error rate.

10 13. The method of claim 1 further comprising adjusting the reference sensitivity based on the estimated antenna gain to calculate the sensitivity of the mobile terminal positioned in the test orientation for each combination of one or more frequency channels with one or more mobile terminal configurations.

15 14. The method of claim 13 wherein the one or more frequency channels comprise a high, a medium, and a low frequency in a frequency operating band of the mobile terminal.

15. The method of claim 13 wherein the one or more mobile terminal configurations comprise a free-space configuration, a left-ear configuration, and a right-ear configuration.

16. The method of claim 1 further comprising:
estimating a second antenna gain when the mobile terminal is positioned in
25 the second test orientation; and

adjusting the reference sensitivity based on the second estimated antenna gain to calculate a second sensitivity of the mobile terminal positioned in a second test orientation.

17. A computer readable medium to store a computer program for calculating a radiated sensitivity of a mobile terminal, the computer program comprising:

program instructions to determine a reference sensitivity of the mobile terminal positioned in a reference orientation;

5 program instructions to estimate an antenna gain of a mobile terminal antenna when the mobile terminal is positioned in a test orientation;

and

program instructions to adjust the reference sensitivity based on the estimated antenna gain to calculate the sensitivity of the mobile

10 terminal positioned in the test orientation.

18. The computer readable medium of claim 17 wherein the program instructions to estimate the antenna gain of the mobile terminal antenna when the mobile terminal is positioned in the test orientation comprises:

15 program instructions to apply a known power level to the mobile terminal antenna when the mobile terminal is positioned in the test orientation;

and

program instructions to compare the known antenna power level to a measured power level reported by the mobile terminal to estimate the

20 antenna gain.

19. The computer readable medium of claim 18 wherein the program instructions to adjust the reference sensitivity based on the estimated antenna gain to calculate the sensitivity of the mobile terminal positioned in the test orientation comprises

25 program instructions to calculate the sensitivity, S , of the mobile terminal according to:

$$S = P_A - P_{meas} + S_r,$$

where P_A represents the known antenna power level, P_{meas} represents the measured power level, $P_A - P_{meas}$ represents the estimated antenna gain, and S_r represents the reference sensitivity.

5 20. The computer readable medium of claim 17 further comprising program instructions to determine a correction factor for each of a plurality of measured power levels reported by the mobile terminal.

10 21. The computer readable medium of claim 20 wherein the program instructions to determine the correction factor for each of the plurality of measured power levels comprises:

15 program instructions to apply a plurality of known power levels to an input of a receiver of the mobile terminal; and
 program instructions to compare each of the known power levels to a corresponding measured power level reported by the mobile terminal
 to determine the correction factor for each measured power level.

20 22. The computer readable medium of claim 20 wherein the program instructions to determine the reference sensitivity of the mobile terminal positioned in the reference orientation further comprises program instructions to apply the corresponding correction factor to the reference sensitivity to determine a corrected reference sensitivity.

25 23. The computer readable medium of claim 20 wherein the program instructions to estimate the antenna gain of the mobile terminal antenna when the mobile terminal is positioned in the test orientation comprises:

program instructions to apply a known power level to the mobile terminal antenna when the mobile terminal is positioned in the test orientation; program instructions to apply the corresponding correction factor to a measured power level reported by the mobile terminal to determine a corrected power level; and

5 program instructions to compare the known antenna power level to the corrected power level to determine a corrected estimate of the antenna gain.

10 24. The computer readable medium of claim 20 wherein the program instructions to adjust the reference sensitivity based on the estimated antenna gain to calculate the sensitivity of the mobile terminal positioned in the test orientation comprises program instructions to calculate the sensitivity, S , of the mobile terminal receiver according to:

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$$S = P_A - P_{corr} + S_{corr},$$

where P_A represents the known antenna power level, P_{corr} represents the measured power level as corrected by the correction factor, $P_A - P_{corr}$ represent the estimated antenna gain as corrected by the correction factor, and S_{corr} represents the reference sensitivity as corrected by the correction factor.

20 25. The computer readable medium of claim 20 further comprising program instructions to determine the correction factors for one or more frequency channels.

26. The computer readable medium of claim 17 wherein the program instructions 25 to determine the reference sensitivity of the mobile terminal positioned in the reference orientation comprises:

- program instructions to apply a known communication signal at one or more known antenna power levels to the mobile terminal antenna when the mobile terminal is positioned in the reference orientation;
- 5 program instructions to receive a looped-back version of each communication signal and corresponding measured power level;
- program instructions to calculate a signal quality of each looped-back version of the communication signal;
- 10 program instructions to compare each of the calculated signal qualities to a predefined signal quality; and
- 15 program instructions to identify the reference sensitivity as the measured power level that generally corresponds to the predefined signal quality.
27. The computer readable medium of claim 17 further comprising program instructions to adjust the reference sensitivity based on the estimated antenna gain to calculate the sensitivity of the mobile terminal positioned in the test orientation for each combination of one or more frequency channels with one or more mobile terminal configurations.
- 20 28. The computer readable medium of claim 17 further comprising:
- program instructions to estimate a second antenna gain when the mobile terminal is positioned in a second test orientation; and
- program instructions to adjust the reference sensitivity based on the second estimated antenna gain to calculate a second sensitivity of the mobile terminal positioned in the second test orientation.
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29. A test system for calculating a radiated sensitivity of a mobile terminal comprising:

a first interface;

5 a sensitivity test processor for configuring the test system in one of a plurality of test modes;

wherein in a first test mode, the test system determines a reference sensitivity of the mobile terminal positioned in a reference orientation via the first interface;

10 wherein in a second test mode, the test system estimates an antenna gain of a mobile terminal antenna via the first interface when the mobile terminal is positioned in a test orientation; and

15 a sensitivity calculator for calculating the sensitivity of the mobile terminal positioned in the test orientation by adjusting the reference sensitivity based on the estimated antenna gain.

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30. The test system of claim 29 wherein in the second test mode, the sensitivity test processor configures the test system to:

apply a known power level to the mobile terminal antenna via the first interface when the mobile terminal is positioned in the test orientation;

20 and

compare the known antenna power level to a measured power level reported by the mobile terminal to estimate the antenna gain of the mobile terminal antenna when the mobile terminal is positioned in the test orientation.

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31. The test system of claim 29 further comprising a second interface, wherein in a third test mode, the test system determines a correction factor for each of a

plurality of measured power levels reported by the mobile terminal via the second interface.

32. The test system of claim 31 wherein in the third test mode, the sensitivity test
5 processor configures the test system to:

apply a plurality of known power levels to an input of a receiver of the mobile terminal via the second interface; and
compare each of the known power levels to a corresponding measured power level reported by the mobile terminal to determine the correction factor
10 for each measured power level.

33. The test system of claim 31 further comprising a memory for storing each correction factor.

15 34. The test system of claim 31 wherein in the second test mode, the sensitivity test processor configures the test system to:

apply a known power level to the mobile terminal antenna via the first interface when the mobile terminal is positioned in the test orientation;
apply the corresponding correction factor to a measured power level reported
20 by the mobile terminal to determine a corrected power level; and
compare the known antenna power level to the corrected power level to estimate the antenna gain of the mobile terminal antenna when the mobile terminal is positioned in the test orientation.

25 35. The test system of claim 31 wherein at least one of the first and third test modes comprise a characterization mode.

36. The test system of claim 31 wherein the second interface comprises a coaxial cable.

37. The test system of claim 29 wherein in the first test mode, the sensitivity test
5 processor configures the system to:

apply a known communication signal at one or more known antenna power
levels to the mobile terminal antenna when the mobile terminal is
positioned in the reference orientation;
receive a looped-back version of each communication signal and
10 corresponding measured power level;
calculate a signal quality of each looped-back version of the communication
signal;
compare each of the calculated signal qualities to a predefined signal quality;
and
15 identify the reference sensitivity as the measured power level that generally
corresponds to the predefined signal quality.

38. The test system of claim 37 wherein the signal quality is a bit error rate.

20 39. The test system of claim 37 wherein the signal quality is a frame error rate.

40. The test system of claim 29 wherein the second test mode comprises a data
collection mode.

25 41. The test system of claim 29 wherein the first interface comprises a test
antenna.